CENTRAL VALLEY FLOOD MANAGEMENT PLANNING PROGRAM

FloodSAFE CALIFORNIA

Central Valley Flood Protection Plan

Round 1 Management Action Workshops
Draft Initial Management Actions

A management action is a specific structural or nonstructural strategy, action, or tactic that contributes to the Central Valley Flood Protection Plan (CVFPP) goals and addresses identified flood management problems in the Systemwide Planning Area, including any identified deficiencies in the State Plan of Flood Control (refer to *CVFPP Interim Progress Summary No.1*). Management actions may range from potential policy or institutional changes, to recommendations for operational and physical changes to the flood management system. Management actions may address one or more CVFPP goals and are the "building blocks" for regional solutions and eventually systemwide solutions.

An initial set of management actions was developed by consolidating a large number of compiled actions and recommendations from published studies and reports, and input from Regional Conditions and Topic Work Groups during CVFPP Phase 1 activities. DWR subject-matter experts provided a preliminary evaluation of the environmental, economic, technical, and social consideration of the identified management actions. Each management action was evaluated against a uniform set of criteria to allow for a consistent comparative analysis.

Management Actions Workshops will refine the initial management actions and develop additional actions to augment this initial set of management actions. For information on Phase 2 Workshops, refer to *Attendee's Guide to Phase 2 Workshops* available at www.water.ca.gov/cvfmp/.

Each management action is evaluated using the *Management Actions Evaluation Form*. For description of the form sections refer to the *Reader's Guide to the Management Actions Evaluation Form* available at www.water.ca.gov/cvfmp/.

To provide detailed written comments on the management action description and evaluation, use the fillable PDF *Comments Form* available at www.water.ca.gov/cvfmp/.

Draft Ecosystem Restoration Management Actions

ID	Management Actions Title
MA-039	Reduce runoff through upper watershed management.
MA-040	Improve quality and quantity of wetland habitat within the flood system.
MA-041	Improve quality and quantity of riparian habitat in the flood system.
MA-042	Improve natural riverine processes by removing un-natural hard points along channels
MA-043	Develop hazardous waste and materials management protocols to identify, contain and remediate potential water quality hazards within floodplains.
MA-044	Reoperate flood-control reservoirs to more closely approximate natural flow regimes.
MA-045	Reduce the incidence of invasive species in the flood management system.
MA-046	Remove barriers to fish passage within the flood system.
MA-047	Set back levees to connect rivers to floodplains.
MA-048	Reconnect floodplains to restore seasonal habitat.

DRAFT Management Action Evaluation

Management Action Title: MA-039

Reduce runoff through upper watershed management.

Description:

Problem:

Runoff from upper watershed source areas has increased, in varying extents, due to increases in impermeable surfaces in developed areas, soil compaction from agriculture, reductions in vegetative cover, incision of stream channels, and losses of wetlands. Runoff flood events will worsen in the next 50-100 years, as regional temperatures rise and winter precipitation falls more frequently as rain, rather than snow. The increased intensity and frequency of winter flooding may overwhelm the existing flood management system on a more regular basis, unless other efforts are taken.

Desired Outcome:

Improved upper watershed management to enhance ecosystem function and attenuate downstream runoff, reduce the rate and magnitude of runoff during precipitation events, and lessen the need to store runoff in large reservoirs.

Methodology:

The State should develop requirements for updating relevant land use plans in upper watersheds to protect and increase the area of wetlands and pass legislation governing subdivisions standards. Plans should be updated to increase vegetative cover, expand wetland areas, install drywells to convert surface runoff to groundwater recharge, "daylighting" concrete lined or culverted drainage channels, and minimize the area of compacted or impermeable surfaces. Local watershed projects to increase soil permeability, increase vegetative cover, increase the area of wetlands , and increase the connectivity between stream channels and floodplains should be supported with technical assistance and funding. Work with land management agencies and local planning agencies in watersheds to reduce the extent of compacted or impermeable surface, reduce the likelihood of catastrophic wildfires and increase overall vegetative cover. This will increase percolation and water retention rates across broader areas and reduce the need for more expensive downstream options. The State may also be able to provide funding to local jurisdictions to accomplish these actions.

CVFPP Goals

Contributes Significantly to: Promote Ecosystem Functions

Potentially Contributes to (Check all that apply):

- ☑ Improve Flood Risk Management
- ☑ Improve Operation and Maintenance
- ☑ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☑ Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retained for further evaluation.

Advantages:

- Will work well in conjunction with other MAs involving setback levees
- Provides environmental, flood risk reduction, recreation, and water quality benefits.
- Reducing runoff results in erosion reduction and reduction of sediment transport.
- Reduces the peak stormwater runoff and decreases the frequency and consequences of flooding.

Disadvantages:

- May reduce potential tax bases of local jurisdictions by limiting development.

Economic Considerations:

Capital Cost? (High, Medium, Low)

The costs to modify the policy would be relatively low. However, capital costs associated with implementation of the policy would be relatively high to the extent physical construction. Setback levees, groundwater recharge areas, drywells, and wetland creation all carry a cost and the cost can be high if done on a large scale. Some of this cost could be shifted to developers responsible for urbanization. Preservation of upper watershed may involve substantial right of way costs for easement agreements and protracted negotiation with landowners, water right holders, and reservoir operators.

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

Improved upper watershed management will reduce the total and peak volume of stormwater discharged to the flood system and associated accelerated erosion and decrease the annual cost for operations/maintenance/repair.

Potential for Cost-Sharing?

Potential cost-sharing with local land use planning agencies for general plan modifications and private developers for project development and implementation.

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

Reducing peak stormwater runoff reduces the frequency and consequences of flooding; thereby reduces long-term costs of emergency response and recovery.

Flood fighting? (Increase, Decrease, or No Significant Change)

Reducing peak stormwater runoff reduces the frequency of flooding; thereby reduces long-term costs of floodfighting. There could also be some reduction in flooding in the upper watershed.

Effect on Damage to Critical Public Infrastructure?

Potential to reduce damage to critical public infrastructure by reducing the frequency and magnitude of flooding.

Effect on Floodplain and Economic Development?

Revised land use plans may inhibit future floodplain development.

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

Reduces the frequency of flooding; thereby reduces State flood responsibility.

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

Upper watershed land management to reduce runoff by reducing impermeable surfaces and revegetation and stream channel and wetland restoration would rehabilitate key hydrologic processes in downstream areas by establishing a more natural hydrograph with attenuating peak flows, recharging groundwater, and increasing the growing season, in addition to the upper watershed habitat benefits.

Adverse Environmental Impact?

None for the policy change, but the physical construction of wetland areas, drywells, setback levees, etc. could have some impact.

Permitting Considerations?

None for changing the policy, but implementation of the policy would require permitting which could be minor to substantial depending on the project that was implemented.

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

Minimal. The improvement of upland watersheds would likely result in a reduction in sediment loads will reduce the impacts associated with downstream flood maintenance.

Social Considerations:

Public Safety?

Improves public safety by reducing the frequency and magnitude of flooding. In addition it will reduce the maintenance on downstream channels and facilities along the valley floor.

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

Potential to enhance recreation and open space values. Potential for water supply benefits by increasing infiltration to groundwater. Delayed groundwater recharge of streams may help maintain instream flows and critical water temperatures for over summering salmonids. Improvement of aquatic and upland habitats within the watershed.

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Likely acceptable at the State level; local implementation may face challenges as implementation would restrict development.

Technical Considerations:

Redirected Hydraulic Impacts?

None. This MA may reduce the total and peak volume of water and sediment discharged to the flood system.

Residual Risk?

This MA reduces peak stormwater runoff, decreasing the frequency and consequences of flooding.

Climate Change Adaptability:

Implementation of the policy created by this action would enhance hydrologic adaptability by reducing the magnitude of potential flood flows, and thus reducing flood risk and moderating potential damage; this enhancement of hydrologic adaptability would also enhance biological adaptability by increasing the amount and complexity of habitat and its continuity along environmental gradients, and by reducing the consequences of extreme events. Additionally, carbon sequestration could increase with wetland creation.

Urban, Small Community, and Non-Urban Considerations:

Potential significant impacts to small and non-urban communities adjacent to or located within the upper watershed. May take education to acquaint small community decision-makers with the benefits to elicit their cooperation and support for implementation. Potential for rural areas to become more involved in watershed restoration improvement and develop a new community esprit de corps identity.

Regional Applicability:

The entire Sacramento and San Joaquin River upper watershed drainages would apply. Not the Delta.

Integration with Other Programs:

Integrated Regional Water Management Program

References:

USACE 2001 Sacramento and San Joaquin River Basins Comprehensive Study;RCR; Feather River Coordinated Resource Management (CRM) Group; Cosumnes American Bear Yuba Integrated Regional Water Management Plan

DRAFT Management Action Evaluation

Management Action Title: MA-040

Improve quality and quantity of wetland habitat within the flood system.

Description:

Problem:

Within the flood system, in reaches with levees, wetlands are confined to a narrow, intermittent fringe, separated by large reaches with limited or only low-quality habitats. Seasonal wetlands are lacking within the lower Sacramento River Basin (with the exceptions of the Yolo and Sutter bypasses and lower Cosumnes River) and are largely absent in the San Joaquin River Basin. Trees, root mats, and other wetland vegetation slow the speed of flood waters and distribute them more slowly over the floodplain. This combined water storage and braking action lowers flood heights and reduces erosion. Wetlands within and downstream of urban areas are particularly valuable, counteracting the greatly increased rate and volume of surface- water runoff from pavement and buildings. The holding capacity of wetlands helps control floods and prevents water logging of crops. Preserving and restoring wetlands, together with other water retention, can often provide the level of flood control otherwise provided by expensive dredge operations and levees.

Desired Outcome:

Increase in the quantity and quality of wetland habitat within the flood system without sacrificing the operability and maintenance of the flood protection works or increase flood risks.

Methodology:

Identify and evaluate areas for potential wetland habitat improvements. The bypass system of the lower Sacramento River offers extensive opportunity of wetland habitat improvements. Develop regional flood system mitigation banks which enhance the quantity and connectivity of wetland habitat. Redesign the flood system to allow for creation and/or connectivity of wetland habitats.

CVFPP Goals

Contributes Significantly to: Promote Ecosystem Functions

Potentially Contributes to (Check all that apply):

- ☑ Improve Flood Risk Management
- ☑ Improve Operation and Maintenance
- ☑ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☑ Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retained for further evaluation.

Advantages:

- Will work well in conjunction with MAs involving setback levees and land use planning.
- Provides ecosystem restoration, and water quality benefits.
- Provide potential mitigation credits to offset O&M and flood project impacts.

Disadvantages:

- Potential for wetland habitat improvements may be limited in areas with extensive urban floodplain development.
- May restrict operation and maintenance.
- Depending on type and location of wetland creation methylation of mercury could be a problem.

Economic Considerations:

Capital Cost? (High, Medium, Low)

Medium. Capital costs associated with enhancing wetlands include costs for permitting, design, and construction of wetlands.

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

Increased monitoring and maintenance of restored wetlands may moderately increase the annual cost to

operate/maintain/repair the flood system. However, wetlands can detain floodwaters and attenuate flood peaks, potentially easing strain on downstream flood protection structures.

Potential for Cost-Sharing?

Potential for cost-sharing with Federal, State, local, and non-governmental agencies interested in habitat restoration, as well as with levee-maintaining agencies in need to offset maintenance impacts.

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

This MA may decrease emergency response and recovery costs by detaining floodwaters in wetlands and attenuating flood peaks downstream.

Flood fighting? (Increase, Decrease, or No Significant Change)

This MA may decrease flood fighting costs by detaining floodwaters in wetlands and attenuating flood peaks downstream.

Effect on Damage to Critical Public Infrastructure?

Any linkage would be location specific and therefore unpredictable if the location is not known.

Effect on Floodplain and Economic Development?

No direct effects; if wetland creation is part of advance mitigation planning it may facilitate floodplain development elsewhere within the flood system by streamlining mitigation processes.

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

Potential to reduce State flood responsibility by attenuating flood peaks downstream of wetlands and reducing the frequency of flooding.

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

Increase wetland area in the flood system could rehabilitate key physical processes and would rehabilitate ecological functions, by improving water quality and providing additional habitat.

Adverse Environmental Impact?

Possibility of mercury methylation depending on the location and type of wetland creation. Potential for impacts to cultural resources.

Permitting Considerations?

Substantial but less complex

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

Habitats that have been affected by flood system O&M would be rehabilitated. Provide potential mitigation credits to offset O&M impacts.

Social Considerations:

Public Safety?

Potential to improve public safety by attenuating flood peaks downstream of wetlands and reducing the frequency of flooding.

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

Potential to enhance recreation and open space values. Potential for water supply benefits by detention of flood water and natural contaminant filtering. Creation/enhancement of "Wildlife Areas" can have recreation benefits including trails, hunting, and/or wildlife viewing.

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Likely to be politically and institutionally acceptable, especially within the existing Sacramento River bypass system. May be more difficult in areas with extensive floodplain development. Additionally, wetland development projects have to compete

for scarce financial resources, so implementation may be slow due to tight budgets.

Technical Considerations:

Redirected Hydraulic Impacts?

Increasing wetland areas will reduce the velocity of flood waters.

Residual Risk?

May reduce residual risk downstream by attenuating flood peaks.

Climate Change Adaptability:

This action would increase biological adaptability by increasing the amount and connectivity of and range of environmental conditions within wetland habitats, and thus, increasing the ability of these habitats to adjust to climate change, and to persist through and recover from extreme events. In addition, wetland creation could ameliorate peak runoff events.

Urban, Small Community, and Non-Urban Considerations:

May be limited potential for wetland habitat improvements in urban areas with extensive floodplain development. However, wetland creation in urban areas may be more critical than in more rural areas, because urban areas typically have lost the greatest percentage of their pre-existing wetlands. Wetland creation in rural areas may be more accepted with cooperative efforts to use coalition building techniques to enhance and restore a board landownership base.

Regional Applicability:

All regions

Integration with Other Programs:

Central Valley Conservation Strategy (FESSRO), Corridor Management Strategy (FMO), Interagency Flood Management Collaborative Program, Fish Passage Improvement Program (FESSRO), Integrated Regional Water Management Program Flood Protection Corridor Program (FPO), Urban Streams Restoration Program (FESSRO) Ecosystem Restoration, other conservation agencies and conservation oriented nonprofit organizations with ongoing wetland programs.

References:

Delta Risk Management Strategy; U.S. Environmental Protection Agency. 1995b. America's wetlands: Our vital link between land and water. Office of Water, Office of Wetlands, Oceans and Watersheds. EPA843-K-95-001. Wetlands: Protecting Life and Property from Flooding; Executive Order 11988: Floodplain Management - an order given by President Carter in 1977 to avoid the adverse impacts associated with the occupancy and modification of floodplains. Cosumnes River Preserve:http://www.cosumnes.org/index.html

DRAFT Management Action Evaluation

Management Action Title: MA-041

Improve quality and quantity of riparian habitat in the flood system.

Description:

Problem:

There has been a loss, fragmentation, and degradation of native riparian habitat within the flood management system and its associated floodplains.

Desired Outcome:

Increased riparian habitat quality, quantity, diversity and connectivity that contributes to a more sustainable flood management system, without compromising flood system function or public safety.

Methodology:

Identify important riparian habitat types and ecosystem processes that need improvements in management, enhancement, and restoration. Identify effective approaches to improve habitat and ecosystem processes that also benefit a variety of important species. Identify candidate areas that are most suitable for improving habitat and meeting other CVFPP goals. Identify opportunities to increase or improve habitat as part of other flood projects and operations. For example, such opportunities exist where levees are currently set back from the low-flow channels of rivers (such as along reaches of the Feather, Yuba, Sacramento, and American rivers, and in the Delta). Opportunities may also exist to create new floodplain habitat, establish habitat within existing or new floodways, or establish habitat on or alongside berms or other engineered features. Increase the quality, quantity, diversity and connectivity of vegetation and habitat within and adjacent to the existing flood management system, with a focus on native riparian, floodplain, and shaded aquatic habitats. Habitat should be established as part of flood facilities (levees, bypasses, channels, etc) in ways that contribute to the long-term, sustainable operation and maintenance of the flood management system, while not compromising the ability to pass design flows. Evaluate hydraulic capacities of bypasses on two-dimensional basis to identify flow constrictions and opportunities for improving habitat.

CVFPP Goals

Contributes Significantly to: Promote Ecosystem Functions

Potentially Contributes to (Check all that apply):

- ☐ Improve Flood Risk Management
- ☐ Improve Operation and Maintenance
- ☑ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☑ Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retained for further evaluation; look for opportunities to combine with management actions involving maintenance, setback levees, and floodplain storage. More research by UC Davis at the large flume at the J. Amorocho Hydraulics Laboratory could resolve various vegetation issues in regards to species impact on flood flows in the central valley rivers.

Advantages:

- Will work well in conjunction with other MAs involving setback levees.
- May improve bank stability.
- Will help offset climate change effects of CO2 in the atmosphere.
- Potential to offset impacts to maintenance activities.
- Riparian vegetation within flood control systems can be designed to have no impact on the flood flows, but to

Disadvantages:

- If timely and appropriate maintenance is not performed, may have upstream hydraulic impacts due to reduced channel capacity.
- Timing of channel maintenance could be limited due to species issues.
- Vegetation could contribute large woody debris downstream that could be a hazard to boater safety.

positively improve the stability of the levees by limiting erosion, absorbing turbulence, increase wildlife habitat, restore native plants communities in the floodways.

Economic Considerations:

Capital Cost? (High, Medium, Low)

Revegetation projects would likely require a low to medium level of initial investment.

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

Initially during the establishment period, costs could be increased and would include monitoring of the site. Once established, habitat maintenance costs are generally low (primarily invasive species control) . Annual O&M and repair costs for flood facilities with increased habitat will vary, depending on the site specific situation. Currently unvegetated facilities may require increased costs for managing vegetation consistent with flood risk reduction goals. In other cases increased vegetative cover may improve bank stability and , reduce erosion rates, reducing the and lower repair costs. Increased vegetation throughout the flood system may reduce the volume of sediment deposited downstream and the needand lower costs for dredging.

Potential for Cost-Sharing?

High potential for cost-sharing with other state, federal, and local agencies and programs for revegetation projects. Potential to leverage local volunteer labor for projects.

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

As vegetation enhancements would be constrained by the requirement to not compromise design flows, there would likely be no significant change in costs for emergency response and recovery. However, increasing the extent of vegetation in locations with setback levees may decrease the level of protection of the levees and may have some upstream hydraulic impacts. These impacts are likely to be minor due to the siting of the setback levees. Vegetation can also protect levees from erosion due to wave wash and scouring, so can protect levee integrity.

Flood fighting? (Increase, Decrease, or No Significant Change)

As vegetation enhancements would be constrained by the requirement to not compromise design flows, obstruct visibility or interfere with flood fighting, there would likely be no significant change in floodfighting costs. However, increasing the extent of vegetation in locations with setback levees may decrease the level of protection of the levees and may have some upstream hydraulic impacts. These impacts are likely to be minor due to the siting of the setback levees.

Effect on Damage to Critical Public Infrastructure?

Region specific

Effect on Floodplain and Economic Development?

Enhancing vegetation in floodplains will not increase floodplain development as these areas are not appropriate for development. Vegetation enhancement will benefit the wildlife habitat and recreation opportunities in the region, which may be an economic benefit to the local community.

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

As vegetation enhancements would be constrained by the requirement to not compromise design flows, there would likely be no significant change in State Flood Responsibility. Establishment of habitats must be coupled with the ability to maintain them for public safety without incurring additional mitigation costs.

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

Increasing the areal extent of vegetation in floodplains will rehabilitate key physical processes and ecological functions. It will enhance riparian and wetland habitats and processes, as well as stabilize banks.

Adverse Environmental Impact?

None. Revegetation of floodplains will have a beneficial environmental impact.

Permitting Considerations?

Could be minor to substantial but streamlined, depending on the extent and nature of habitat projects. These may include NEPA, CEQA, CDFG stream alteration permits, CWA 401, 402, and 404 permits, for example, if construction activities affect aquatic environments. Opposition to revegetation by those who view it as negatively affecting flood flows could delay the permitting process.

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

Habitat improvement projects can provide mitigation opportunities for habitat losses elsewhere in the FM system. if coupled with long-term agreement for operation and maintenance, revegetation can stabilize banks and reduce downstream sediment yield, reducing the need for dredging operations.

Social Considerations:

Public Safety?

As vegetation enhancements would be constrained by the requirement to not compromise design flows and to allow for future maintenance, there would likely be no significant change in public safety impacts.

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

Habitat improvement projects can provide opportunities for recharging ground water, stabilizing banks and reducing downstream sediment yield. Increased vegetation may enhance aesthetic, recreational, and open space values within floodplains and increase recreational opportunities (e.g. trails, hunting, fishing, waterway access). Reconnecting rivers to floodplains in low-risk areas provides an opportunity to improve water quality in a long-term sustainable way at relatively low costs. Active flood plains and associated wetlands can temporarily store floodwaters, filter nutrients and impurities from runoff, process organic wastes, capture high sediment loads outside of the main flood channel, and moderate water temperature fluctuations.

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Establishing additional vegetation in the flood system is still controversial, but well-designed projects to restore habitat along major rivers (e.g., O'Connor Lakes restoration project and Abbott Vegetation Restoration on the Feather River) are supported by many sectors, including natural resource agencies, infrastructure agencies, environmental organizations, and recreational interests. However, these projects have to compete for scarce financial resources, so implementation may be slow due to funding limitations.

Technical Considerations:

Redirected Hydraulic Impacts?

As vegetation enhancements would be constrained by the requirement to not compromise design flows, there would likely be no significant change in upstream hydraulic impacts. Potential increase in large woody debris in channel downstream if timely and appropriate maintenance is not performed.

Residual Risk?

As vegetation enhancements would be constrained by the requirement to not compromise design flows, there would likely be no significant change in residual risk. Potential increase in large woody debris in channel downstream if timely and appropriate maintenance is not performed. Long term maintenance standards and funding should be established as much as possible at the time of project implementation to avoid issues with future maintenance.

Climate Change Adaptability:

This action would enhance biological adaptability by increasing habitat quantity, connectivity, complexity, and continuity across environmental gradients; and thus, increasing the size and viability of populations, and their ability to handle and adjust to the consequences of climate change. An increase in vegetation will help offset climate change by removing CO2 from the atmosphere.

Urban, Small Community, and Non-Urban Considerations:

Local opposition to vegetation restorations from the common belief that all riparian vegetation growing within the channel is a

problem, because of fears that the vegetation will slow or re-direct the flows.

Regional Applicability:

All regions

Integration with Other Programs:

Central Valley Conservation Strategy (FESSRO), Corridor Management Strategy (FMO), Interagency Flood Management Collaborative Program, Flood Corridor Program (Projects Office), Natural Community Conservation Plans and Habitat Conservation Plans (several), Riparian Habitat Joint Venture, Central Valley Habitat Joint Venture, species recovery plans, other conservation agencies and non-profits.

References:

USACE 2001 Sacramento and San Joaquin River Basins Comprehensive Study;RCR; http://www.riverpartners.org/riparian-ecology/veg-floodway/the-flume.html;http://www.cosumnes.org/index.html, http://cabyregion.org/; http://cherokeewatershed.org/index.php; http://www.feather-river-crm.org/

DRAFT Management Action Evaluation

Management Action Title: MA-042

Improve natural riverine processes by removing un-natural hard points along channels

Description:

Problem:

Unnatural hard points - such as bridge abutments, rock revetment, dikes, or other physical encroachments into a channel or waterway can affect the hydraulics of river channels, constraining dynamic natural fluvial geomorphologic processes of erosion, deposition, and channel meander that contribute to healthy and sustainable ecosystems.

Desired Outcome:

Promote natural physical processes that support essential ecosystem functions within the flood management system.

Methodology:

Changing the physical features of the conveyance system by removing hard points, such as rock revetment, dikes, or other structures in the river, can improve ecosystem functions by promoting natural erosion and deposition processes, aquatic and terrestrial habitat heterogeneity, and successional habitat development. However, removing hard points must be commensurate with replacement of a feature that affords like function (e.g., level of protection, water management, vehicular passage), and must not restrict operability or maintainability of the flood protection works. Riparian, wetland, shallow water, and terrestrial habitats could be integrated into this measure in ways that do not reduce flood flow capacity. In some cases, removal, modification, or relocation of hard points can also contribute to flood damage reduction by reducing constrictions or improving channel capacity. This management action could also incorporate vegetation types or features that improve or facilitate operation and maintenance of the flood management system.

CVFPP Goals

Contributes Significantly to: Promote Ecosystem Functions

Potentially Contributes to (Check all that apply):

- ☑ Improve Flood Risk Management
- ☐ Improve Operation and Maintenance
- ☑ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☐ Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retain for future evaluation after systemic problems have been resolved.

Advantages:

- Improves natural geomorphologic processes (deposition, erosion, meander).
- Supports self-sustaining ecosystem functions (transitional or successional habitat).
- Potential to reduce flood risk if coordinated with actions that remove channel constrictions and improve conveyance.
- When incorporated with riparian forest restoration, bank erosion provides the process to directly incorporate large woody habitat into the aquatic environment.

Disadvantages:

- Would need to be implemented in ways that do not impact levee or flood system integrity (erosion, meander).
- Potential loss of Federal cost-sharing for bank protection and PL 84-99 accreditation if implementation cannot be shown to maintain existing level of protection.

Economic Considerations:

Capital Cost? (High, Medium, Low)

Medium to High initial investment depending on number, location, and types of hard points and treatments implemented. Low, where the end result can be accomplished by simply eliminating maintenance and repair.

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

Unable to determine at this time; potential to increase maintenance and repair costs if leads to significant erosion on or near flood management facilities; although, implementation of this management action is unlikely under those circumstances . Alternately, could reduce maintenance and repair costs over time if erosion and other factors are considered and accounted for as part of implementation. Also, will represent a significant cost savings where bank revetment has no direct affect on flood risk reduction.

Potential for Cost-Sharing?

Potential for Federal cost sharing via contributions to existing Federal project purposes (environmental restoration). Additional cost-sharing must be commensurate with potential loss of existing Federal cost-sharing for bank protection (Sac Bank).

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

Will eliminate costs of response and repair where revetment is no longer maintained, but must not jeopardize PL 84-99 eligibility.

Flood fighting? (Increase, Decrease, or No Significant Change)

Encroachments may obstruct visibility or restrict the use of some flood fighting method.

Effect on Damage to Critical Public Infrastructure?

Cannot determine at this time (site specific)

Effect on Floodplain and Economic Development?

No direct effects

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

Potential increase in liability if not combined with actions to reduce flood conveyance constrictions and strengthening of levees. Responsibility will be reduced by removing maintenance and repair of bank revetment that does directly contribute to reducing flood risk.

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

Reducing flow constrictions and hard points would rehabilitate physical processes, including sediment transport and channel forming processes, and would improve aquatic and riparian habitat as a result of enhancing physical processes (particularly if habitat is incorporated into action).

Adverse Environmental Impact?

Potential construction impacts (temporary or permanent) associated with physical removal of hard points; however, these impacts would be offset by long-term environmental benefits of the action.

Permitting Considerations?

Substantial, but streamlined.

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

Habitats that have been affected by flood system construction and O&M would be rehabilitated to the extent possible considering the need for future maintenance.

Social Considerations:

Public Safety?

Potential to improve public safety if combined with actions to reduce flood flow constrictions (increase flood system capacity) and address erosion of flood management features. Potential to decrease public safety if commensurate level of protection cannot be achieved, continued maintenance is not possible, and PL 84-99 accreditation is lost.

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

Would improve and/or provide aesthetics, recreation, natural riparian vegetation, and salmon rearing and bank swallow nesting habitat.

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Removal of hard points has been advocated by local governmental bodies and landowners who share in the cost and responsibility of maintaining revetment that does not reduce flood risk.

Technical Considerations:

Redirected Hydraulic Impacts?

If removal of hard points increases channel capacity, could result in hydraulic impacts downstream

Residual Risk?

Potential to impact downstream conveyance capacity and weaken existing levees increasing overall flood risks.

Climate Change Adaptability:

Restoring wetlands to a more natural state will enhance their adaptability to climate change.

Urban, Small Community, and Non-Urban Considerations:

Potential loss of federal cost-sharing for bank protection.

Regional Applicability:

Potentially applicable in all regions where hard points exist; removal of hard points may not be suitable in areas where levees are subject to significant erosion/scour

Integration with Other Programs:

Central Valley Conservation Strategy (FESSRO), Corridor Management Strategy (FMO), Interagency Flood Management Collaborative Program

References:

USACE 2001 Sacramento and San Joaquin River Basins Comprehensive Study;

DRAFT Management Action Evaluation

Management Action Title: MA-043

Develop hazardous waste and materials management protocols to identify, contain and remediate potential water quality hazards within floodplains.

Description:

Problem:

Flooding can impair water quality through the mobilization of hazardous materials or contaminants on floodplains. These materials or contaminants may originate from mines, feed lots, fuel tanks, septic systems, landfills, illegal dumping, or other sources. In addition, flooding events following prolonged droughts may result in, increased water quality impacts from pollutants in the watershed being carried by the runoff. Also, increased runoff during the flood season that temporarily inundates floodways in areas know to have high levels of mercury may also impact water quality by increasing methylmercury levels .

Desired Outcome:

Protocols should be developed to manage hazardous waste and materials in the floodplain. Hazardous materials should be identified, contained and remediation conducted, if necessary.

Methodology:

Coordinate with Regional Water Quality Control Boards to develop protocols outlining ways to identify, contain, and remediate potential water quality hazards prior to a flood event. A protocol should be developed to safely use, reuse, and treat sediment contaminated with hazardous materials, including methylmercury. Additional research will need to be conducted to identify potential water quality hazards. Containment and remediation will be dependent upon the type and location of hazards found

CVFPP Goals

Contributes Significantly to: Promote Ecosystem Functions

Potentially Contributes to (Check all that apply):

- ☑ Improve Flood Risk Management
- ☐ Improve Operation and Maintenance
- ☑ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☑ Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retain for future evaluation after systemic problems have been resolved.

Advantages:

- Works in conjunction with other actions that increase river connection to floodplains.
- Promotes multiple benefits including ecosystem services, water supply, and public safety.

Disadvantages:

- Does not directly reduce the risk of flooding.
- Costs for hazardous waste removal could be high.

Economic Considerations:

Capital Cost? (High, Medium, Low)

Policy MAs will have a substantially lower capital cost than other MAs which involve structural modifications. Example of capital investments include: Funding for planning activities; Funding for communication system upgrades, etc. Some testing/monitoring may be required for protocol/plan development. Potential for increase in up-front capital cost if areas known to have hazardous materials (including methylmercury) are treated or cleaned prior to flood event. The cost to contain and remediate hazardous materials could be substantial, depending on the type and location of materials.

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

Development of the new protocols will lead to no significant change in the annual cost to operate/maintain/repair the flood management system.

Potential for Cost-Sharing?

Potential for cost sharing with US EPA and CA DTSC. Additional potential for coordination with ongoing TMDL projects.

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

No significant change in emergency response costs, but potential decrease in recovery costs due to reduced level of hazardous materials in sediment deposited by floodwaters.

Flood fighting? (Increase, Decrease, or No Significant Change)

This MA will not change the frequency of flooding and will have no significant effect on flood fighting costs.

Effect on Damage to Critical Public Infrastructure?

May reduce the concentration of hazardous materials in sediment deposited on infrastructure during flood events.

Effect on Floodplain and Economic Development?

This MA may result in land-use restrictions and restrictions on industrial activities within the floodplains .

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

By decreasing the potential for spread of contaminants from flooding, this MA would likely decrease state flood responsibility if responsibility for specific areas of known or potential sources of contamination can be identified prior to flood events.

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

Would indirectly contribute to rehabilitation of key physical processes and ecological functions by developing protocols for known highly contaminated areas and cleaning up those areas. Once a protocol is approved and addressed, and the contamination is cleaned up, contamination as a direct result of flooding would be reduced. This could therefore increase use of floodplains and flood basins for flood management by reducing hazards and obstacles to the use of that land.

Adverse Environmental Impact?

None

Permitting Considerations?

There are no expected permitting considerations for the development of the protocols; however, permits would be required if remediation is necessary.

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

This management action would inform levee maintaining agencies of potential for hazardous materials and provide protocols for addressing them. The information developed could be used to plan for O&M and repairs to the system.

Social Considerations:

Public Safety?

This MA would enhance public safety by reducing human health risks from hazardous materials mobilized by flooding.

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

This MA would improve water supply by reducing the loading of contaminants; reducing contaminants could also improve recreational opportunities within the system

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Existing programs to reduce contaminant loading to rivers have publicized this issue, improving its probability of political and institutional acceptance. However, there is potential for political concerns if protocols affect existing industries operating on floodplains.

Technical Considerations:

Redirected Hydraulic Impacts?

None

Residual Risk?

N/A

Climate Change Adaptability:

This action would enhance biological adaptability by reducing an adverse effect of larger flood events on water quality and aquatic and riparian species. - Protocols addressing mercury methylation could provide decision makers with tools to adapt to the changing inundation regimes that may result from climate change.

Urban, Small Community, and Non-Urban Considerations:

No specific considerations identified.

Regional Applicability:

All regions

Integration with Other Programs:

References:

RCR;

DRAFT Management Action Evaluation

Management Action Title: MA-044

Reoperate flood-control reservoirs to more closely approximate natural flow regimes.

Description:

Problem:

Reservoir operators manage storage and releases for many competing uses. By altering flow regimes, the same dam that attenuates flood peaks and protects public safety also alters downstream hydrologic processes in ways that may be incompatible with supporting viable ecosystems within the system streams. Current operations may reduce habitat complexity, limit habitat access for aquatic and terrestrial species, and alter the in-stream flow regimes necessary to sustain floodplain and riparian habitat. By reducing seasonal flow fluctuations, system reservoirs can contribute to channel aggradation (thus, reducing channel capacities), the establishment of invasive species, and also restrict the availability of habitat necessary for species survival (i.e., the absence of seasonal flows that would, under natural conditions, flush fine sediment and redistribute bed sediment that is used by spawning anadromous species).

Desired Outcome:

Re-operate reservoirs on a short-term, periodic basis to support ecosystem needs while also protecting water supplies and allowing adequate reservoir storage space for flood management.

Methodology:

Coordinate with ecosystem managers to discern ways in which ecosystem processes can be better supported by non-emergency reservoir operations, while still managing storage space for necessary water supply and flood management. The releases should optimize the duration and timing of flows needed to sustain viable ecosystems and the inundation of floodplain habitat currently connected to streams within the flood system. Changes in releases must also accommodate necessary flood maintenance requirements. Channel maintenance may benefit from flushing flows, which could assist with vegetation management and snag removal, while also serving ecosystem needs. Although this action addresses non-flood operation of reservoirs, it supports an overarching goal of the CVFPP to manage the flood system for multiple benefits.

CVFPP Goals

Contributes Significantly to: Promote Ecosystem Functions

Potentially Contributes to (Check all that apply):

- ☐ Improve Flood Risk Management
- ☑ Improve Operation and Maintenance
- ☑ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☐ Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retain for further evaluation

Advantages:

- Will work well in conjunction with other MAs involving floodplain reconnection, instream habitat, conjunctive management, and wetland creation.

Disadvantages:

- May be politically/institutionally difficult to implement.
- May affect long-term water supply reliability.
- May affect recreational opportunities at reservoirs and river downstream.
- May increase FMO's maintenance responsibilities.
- May increase downstream flooding.

Economic Considerations:

Capital Cost? (High, Medium, Low)

Medium. Capital costs associated with modifying dam outlet features or constructing auxiliary spillways.

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

This MA may decrease hydropower benefits, increase the net annual cost to operate/maintain/repair.

Potential for Cost-Sharing?

Potential for cost sharing with federal dam operators.

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

No significant change in emergency response and recovery costs, as reoperation would likely be constrained to avoid increasing the frequency of flooding.

Flood fighting? (Increase, Decrease, or No Significant Change)

No significant change in flood fighting costs, as reoperation would likely be constrained to avoid increasing the frequency of flooding.

Effect on Damage to Critical Public Infrastructure?

No significant effect on damage to critical public infrastructure, as reoperation would likely be constrained to avoid increasing the frequency of flooding.

Effect on Floodplain and Economic Development?

The increased flows would not be flooding flows and thus unlikely to significantly affect floodplain development.

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

No significant effect on State flood responsibility, as reoperation would likely be constrained to avoid increasing the frequency of flooding.

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

Re-operating flood control reservoirs to more closely approximate natural flow regimes would rehabilitate key physical processes and ecosystem functions, by reducing scour and deposition of sediment, by providing appropriate flows for fish migration, rearing and spawning, and by providing opportunities for establishment of native riparian tree species such as cottonwoods and willows.

Adverse Environmental Impact?

None

Permitting Considerations?

Permits for reoperation would be substantial but less complex. Permitting with FERC would be required. As as result of this MA, permitting for maintenance actions could become more complicated.

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

None

Social Considerations:

Public Safety?

No significant change to public safety, as reoperation would likely be constrained to avoid increasing the frequency of flooding.

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

Potential to provide recreation and fisheries benefits by changing the flow regime. Potential for avian benefits as well as preserved open space. Potential for fish and wildlife enhancement.

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

May face political and institutional opposition, as existing release patterns provide hydropower and water supply benefits to

current users of the system. Re-operation will also need to show it will not hydraulically impact the flood flow regime or increase risks.

Technical Considerations:

Redirected Hydraulic Impacts?

Will alter flow patterns downstream of dams.

Residual Risk?

No significant change to residual risk, as reoperation would likely be constrained to avoid increasing the frequency of flooding.

Climate Change Adaptability:

This action would increase biological adaptability by increasing habitat complexity, connectivity, and continuity along environmental gradients; and thus, increasing the ability of species to handle and adjust to the consequences of climate change (e.g., extreme events). However, more preciptation in the form of water may force larger releases in the rainy season.

Urban, Small Community, and Non-Urban Considerations:

No specific considerations identified

Regional Applicability:

Not directly applicable in Delta Region, but may be used to improve fisheries and habitat in the Delta. Changes in flow could change position of X2. Strict salinity standards currently exist in the Delta if greater variations in flows were managed for this could help prevent establishment of invasive species in the Delta and enhance native species.

Integration with Other Programs:

Reservoir reoperation studies (HAFOO, future program), Forecast-Coordinated Operations Program (HAFOO) including the Yuba-Feather Forecast-coordinated Operationis Program, Forecast-Based Operations Program and FMO

References:

USACE 2001 Sacramento and San Joaquin River Basins Comprehensive Study;

DRAFT Management Action Evaluation

Management Action Title: MA-045

Reduce the incidence of invasive species in the flood management system.

Description:

Problem:

Invasive species have spread through the flood management system, causing problems for both ecosystems and flood management. The past and continuing introduction of aquatic, riparian, and upland invasive species can reduce the effectiveness of flood management facilities by 1) decreasing the channel capacity; 2) increasing rate of sedimentation; and 3) increasing maintenance costs. Non-native, invasive plant species that are especially detrimental to native ecosystems are widespread within the study area where they often out-compete native plants for light, space, and nutrients, further degrading habitat quality for native fish and wildlife. Introductions of nonnative and invasive species have contributed to a decline in the number and function of native wildlife and plant communities (Cohen and Carlton, 1998). The Central Valley and Delta now contain an unknown number of nonnative species, and a new species (many of which are aquatic invertebrates) is estimated to be introduced at least every 14 weeks (Cohen and Carlton, 1998).

Desired Outcome:

Effective control of invasive species in the flood management system. Modification of regulations to avoid using non-native plants for revegetation efforts within the flood system. Best management practices should be instituted for the treatment and control of wide-spread non-native invasive plant species populations within the flood management system.

Methodology:

Revise and update regulatory standards (Section 131 of the California Code of Regulations Title 23 Division 1 Chapter 1 Article 8) to prohibit introduction of non-native species in the flood management system. Locate and map invasive species in flood management system. Establish long-termed agreement for effective control of invasive species that includes the use of mechanized equipment and herbicide while conducting investigation for means of eradicating invasive species and prevent their future introduction. Avoid the use of invasive non-native plants in revegetation efforts. Remove these species from approved lists in the current CVFPB flood system regulatory standards (Article 8, ss 131). Locations of the invasive giant reed (Arundo donax); saltcedar (Tamarix ramosissima); purple loosestrife (Lythrum salicaria);tree of heaven (Ailanthus altissima); scarlet wisteria (Sesbania punicea); parrot feather (Myriophyllum aquaticum); Himalyan blackberry (Rubus discolor); aquatic primrose (Ludwigia peploides); yellow starthistle (Centaurea solstitialis); Spanish broom (Spartiurn junceum); French broom (Genista monspessulana); Scotch broom (Cytisus scoparius); skeleton weed (Chondrilla juncea) and other non-native invasive plant species in and adjacent to water channels should be mapped and eradicated or otherwise treated and controlled using best management practices.

CVFPP Goals

Contributes Significantly to: Promote Ecosystem Functions

Potentially Contributes to (Check all that apply):

- ☑ Improve Flood Risk Management
- ☐ Improve Operation and Maintenance
- ☑ Promote Ecosystem Functions
- ☑ Improve Institutional Support
- ☐ Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retained for further evaluation.

Advantages:

- Will work well in conjunction with other MAs involving ecosystem restoration and channel maintenance.
- May provide potential mitigation credit to offset impacts

Disadvantages:

- May have a minor downstream hydraulic impacts due to increased upstream channel capacity.
- May take 5 years or more to materialize the benefit.

from maintenance.

Economic Considerations:

Capital Cost? (High, Medium, Low)

Medium. Lower cost relative to structural improvements, but potential costs related to permitting, maintenance, mapping, and technical evaluation on how to eradicate invasive species from the flood management system.

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

Increase in the annual maintenance budget will be needed to control the spread of invasive species. Additional funding will also be needed to develop channel specific management plans and evaluate complete removal and prevention of future infestation of invasive species. In the long term, there may be initial increase funding needs for native species planting to reduce future invasive from returning.

Potential for Cost-Sharing?

Potential for cost sharing with other State and federal ecosystem restoration programs, local non-governmental organizations, and levee maintaining agencies.

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

Reducing the quantity of invasive plants within the flood system has the potential to increase channel capacity, and decrease the frequency of flooding. This would decrease emergency response and recovery costs.

Flood fighting? (Increase, Decrease, or No Significant Change)

Reducing the quantity of invasive plants within the flood system will provide responder greater visibility to monitor the channels and respond proactively to prevent flooding (levees that are not choked of vegetation allows for application of more flood fighting techniques). Reduced vegetation will also improve channel capacity decreasing the risk of flooding thereby decreasing potential costs associated with flood fighting.

Effect on Damage to Critical Public Infrastructure?

Region specific.

Effect on Floodplain and Economic Development?

Unlikely to have significant effect on floodplain development.

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

Potential to increase the State's responsibility because control and eradication needs to a component of the overall channel management plan that include areas or reaches outside of the State-federal flood protection works.

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

Reducing the spread of invasive plants would rehabilitate key physical processes and key ecosystem functions, because some invasive plants obstruct flow and sediment transport, cause excessive channel and bank erosion, by deflecting current, and compete with native vegetation for light water and nutrients and provide no or less habitat value for native wildlife species. Active management of the channels to reduce obstructions to flow and improving the sediment transport will improve channel conveyance and minimize channel and bank erosions. Improvements on flood management system should include consideration of rehabilitation of key physical processes and ecosystem functions where feasible.

Adverse Environmental Impact?

None

Permitting Considerations?

Ongoing

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

The magnitude of adverse effects to habitats resulting from flood system O&M would be reduced.

Social Considerations:

Public Safety?

Increasing channel capacity by removing invasive plant species would reduce the frequency of flooding and improve public safety.

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

Potential for enhanced recreation, wildlife, and fisheries benefits.

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Likely to be politically and institutionally acceptable.

Technical Considerations:

Redirected Hydraulic Impacts?

Potential to increase flow velocity, and/or increase capacity where invasive plants are removed.

Residual Risk?

Potential to increase channel capacity and reduce residual risk.

Climate Change Adaptability:

This action enhances biological adaptability by reducing the displacement of native vegetation, which both reduces a potential adverse consequence of climate change and enhances the ability of native species to handle and adjust to the consequences of climate change by reducing the loss of habitat and its continuity along environmental gradients. Restoring channels to a more natural state will enhance their adaptability to climate change.

Urban, Small Community, and Non-Urban Considerations:

No specific considerations identified at this time.

Regional Applicability:

All regions

Integration with Other Programs:

Central Valley Conservation Strategy (FESSRO), Channel Maintenance Program (PMO), Environmental Initiative Program (FMO)

References:

Environmental Sustainability Summary; Boyle & Associates, 2008. Madera County Integrated Regional Water Management Plan;

DRAFT Management Action Evaluation

Management Action Title: MA-046

Remove barriers to fish passage within the flood system.

Description:

Problem:

The single most major impact to California's native anadromous fish populations has been the construction of our major valley rim dams that are part of the flood and water supply systems in CA. The problem is that 80-90% of the historic spawning and rearing habitat has been made inaccessible to all fish for the last 50+ years. These dams were allowed to be built without the legally mandated fish passage facilities under DFG code of regulations, and hatcheries were supposed to offset the impact. Hatcheries have caused still continued declines in the salmon and steelhead genetics of the populations. Without future access to their historic upper watershed habitats these populations will continue in decline and especially when climate change effects will cause there to be less snow and more rain, reducing the amount of cold water available to release below these major dams. By not allowing fish upstream of these major facilities the water costs of maintaining cold water below the dams in the hotter valley floor will become impossible. Refer to modeling studies done by Surface Storage Investigations in DSIWM for results on water costs from warming climate conditions. Historic upstream habitats will be the only suitable habitat available that will not have future water costs as significant as the current operations of the major rim dams. Planning for future sustainability of water supplies and better flood operations at dams will require serious consideration of passing anadromous fish upstream of dams into the historic habitat remaining.

Desired Outcome:

Reduce the number of physical barriers to fish passage within the flood system without impacting the flood management system's ability to ensure public safety and limiting other water management strategies. This includes providing new passage past the major rim dams to provide access to remaining cold water spawning and rearing habitats upstream in the higher elevation watersheds. The flood control system dams will require physical modifications to provide volitional passage by fish moving up or downstream past these large dams. Improved water management options for water supply and flood release strategies further improving system sustainability and reliability in the face of climate change.

Methodology:

Identify physical barriers which inhibit fish passage within the flood system and acknowledge their significant contribution to the decline of the populations. Evaluate opportunities for enhancing fish passage through these obstructions, including installation of fish ladders or removal of the structures. Coordinate with existing fish passage removal programs with other State and Federal programs. Implement feasibility studies to assess and test ladder options and other ideas for passage around dams.

CVFPP Goals

Contributes Significantly to: Promote Ecosystem Functions

Potentially Contributes to (Check all that apply):

- ☑ Improve Flood Risk Management
- ☐ Improve Operation and Maintenance
- ☑ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☑ Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retained and developed further through Systems Re Operations feasibility studies; look for opportunities to combine with management actions involving setback levees and floodplain storage.

Advantages:

- Significant ecosystem benefits.
- Economic improvements, reduced regulatory restrictions

Disadvantages:

- High capital cost.
- Politically sensitive.

possible, more flexibility in water supply management, less flood management risks, significant improvements in fish use of available historic habitat resulting in improved populations over long term, improved climate change adaptability.	• Short-term construction cost during implementation. • Resistance from local landowners to ESA species in areas where they have not been in many years. • Impacts early rules implemented to protect upstream habitat and fish. • Removal of barriers may compromise a facility ability to provide adequate storage, or prevent it from meeting its design capacity. • Complex agreements needed for water management. • Complex and lengthy permitting process (and costly).

Economic Considerations:

Capital Cost? (High, Medium, Low)

Medium to High. Removal or modification of fish passage barriers may entail significant initial capital cost associated with demolition, construction, and restoration activities. Additionally, there will be costs associated with reoperation of water management for deliveries and usage that will require adoption of agreements from various parties (private, local, state and federal).

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

The removal of some barrier structures are unlikely to change annual cost to operate/maintain/repair. Many structures provide no flood control benefits, and their removal would not dramatically impact operations and maintenance of the flood system. However, flood management dams would require some new O&M for fish ladders or similar structures for fish passage. O&M would increase over current facilities O&M costs. These costs would be offset by water costs savings in delivery options and management flexibility and potential for less water delivery restrictions with increased fish populations and access to other beneficial habitat upstream of major dams.

Potential for Cost-Sharing?

Potential for cost-sharing with agencies with existing fish passage removal programs, such as the California Coastal Conservancy, the California Department of Fish and Game, CALFED, and NOAA Fisheries Services. Potential for cost-sharing with landowners impacted by erosion resulting from these barriers.

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

Potential to decrease emergency response and recovery costs. Potential to decrease frequency of flooding and improve level of protection upstream of barriers.

Flood fighting? (Increase, Decrease, or No Significant Change)

Likely no significant change to flood fighting costs, but unknown at this time.

Effect on Damage to Critical Public Infrastructure?

Region specific.

Effect on Floodplain and Economic Development?

Little to no effect on floodplain development. Potential to decrease frequency of flooding and improve level of protection upstream of barriers.

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

No significant change in State flood responsibility, Potential to decrease frequency of flooding and improve level of protection upstream of barriers.

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

Removing fish migration barriers would rehabilitate key ecological functions by enhancing salmonid migration and access to spawning habitat. Major economic and ecological benefits to the State and potentially economic interests beyond California

and the Central Valley.

Adverse Environmental Impact?

None

Permitting Considerations?

Substantial but less complex

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

The magnitude of adverse effects to habitats resulting from flood system O&M would be reduced. Significant savings to O&M environmental obligations with recovery of endangered species fish populations

Social Considerations:

Public Safety?

Potential to improve public safety by reducing flooding upstream of barriers. May provide improved options for flood management strategies.

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

Potential to provide recreational fisheries benefits. Major water supply and economic benefits could be realized by implementing passage at major dams through improve water supply reliability, improved ecosystem functions and habitat conditions, and improved conditions for commercial and recreational salmon fishing industry

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Removal or modification of smaller fish passage barriers is likely to be more politically and institutionally acceptable than removal of larger barriers such as large flood control and water supply dams and weirs may face stronger political and institutional resistance.

Technical Considerations:

Redirected Hydraulic Impacts?

Removal of barriers could result in a reduced upstream flooding; increased velocities and sediment loads downstream of barriers. Better flood and water supply management flexibility through the years. Installation of fish ladders would result in no significant redirected hydraulic impacts.

Residual Risk?

Reduces residual risk to existing development upstream from barriers.

Climate Change Adaptability:

This action would increase biological adaptability by increasing the amount, connectivity, and variety of habitat available to fish species, and thus, increasing the size of fish populations and their ability to handle and adjust to the consequences of climate change. Allowing salmon and other fish access to upper watersheds above current barriers may become an essential management action as conditions on the valley floor deteriorate. This is the only major opportunity to provide significant adaptation strategies at major dams that will allow for accommodating climate change and still protect public trust resource populations.

Urban, Small Community, and Non-Urban Considerations:

There are many possible benefits to local and regional community economies from construction, water supply economies and recreation supported by improved salmon populations.

Regional Applicability:

All regions

Integration with Other Programs:

Central Valley Conservation Strategy (FESSRO). Major opportunities for integration with new water supply options and flexibility. Integrate with DRIWM and Delta ecosystem enhancements.

References:

DRAFT Management Action Evaluation

Management Action Title: MA-047

Set back levees to connect rivers to floodplains.

Description:

Problem:

Construction of levees immediately adjacent to streams, continual bank protection and channel stabilization not only reduces floodplain storage capacity resulting in larger downstream flooding, but can also severely modify natural geomorphic processes such as erosion, deposition, and channel meandering. Construction of levees also limits area available for riparian forest development resulting in loss of shaded riverine habitat, large woody debris, and limited insect availability for foraging fish. Channelization leads to higher flushing flows moving sediments and gravels out of the system resulting in a loss of material to be used by salmonids. Loss of river connection to floodplains also results in the loss of the shallow water overland flooding that periodically takes place which provides foraging and rearing habitat for young salmonids and splittail, allows for greater ground water recharge, and provides foraging habitat for wintering shorebirds and waterfowl.

Desired Outcome:

Expand the footprint of the flood system to reconnect floodplains, increase detention and attenuate flood flows, reduce downstream flood risks, minimize O&M costs, and restore critical habitats.

Methodology:

Identify areas where levees could feasibly be breached or set back from the existing low flow channel. Leverage existing knowledge and ongoing projects to identify opportunities for setting back levees.

CVFPP Goals

Contributes Significantly to: Promote Ecosystem Functions

Potentially Contributes to (Check all that apply):

- ☑ Improve Flood Risk Management
- ☑ Improve Operation and Maintenance
- ☑ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☑ Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retained for further evaluation

Advantages:

- Will work well in conjunction with other MAs involving ecosystem restoration, transient storage, and land use planning.
- Provides multiple benefits.
- Will also help to streamline permitting.

Disadvantages:

- Potential for setback levees may be limited in areas with extensive floodplain development.
- Potentially high costs of land acquisition and permitting complexities.

Economic Considerations:

Capital Cost? (High, Medium, Low)

High. Setting back levees may have significant capital cost associated with land acquisition and physical construction.

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

This MA is likely to decrease the annual cost to operate/maintain/repair by reducing stress on levees and attenuating flood flows.

Potential for Cost-Sharing?

Potential for cost sharing with local flood control agencies, Federal, and non-governmental organizations.

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

Constructing setback levees can decrease stresses on the levees by attenuating flood flows thereby increasing the existing level of protection afforded and lowering the potential for flooding therefore reducing the frequency of emergency response and associated costs for recovery.

Flood fighting? (Increase, Decrease, or No Significant Change)

Constructing setback levees can decrease stresses on the levees by attenuating flood flows thereby increasing the existing level of protection afforded and lowering the potential for flooding and costs associate to fight floods.

Effect on Damage to Critical Public Infrastructure?

Constructing setback levees can decrease stresses on the levees by attenuating flood flows thereby increasing the existing level of protection afforded and lowering the potential for flooding and costs associate damages to infrastructure.

Effect on Floodplain and Economic Development?

This MA will place floodplain land inside of the footprint of the flood system, reducing the land available for future floodplain development.

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

Decreases State flood responsibility by increasing the conveyance capacity between levees and reducing flood frequency.

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

Would rehabilitate key physical processes by reconnecting channels to historical floodplains, and enhancing sediment transport, channel and floodplain forming processes, groundwater recharge, and improving water quality, and would rehabilitate ecological functions by increasing riparian and wetland habitat area, quality diversity and connectivity, and by increasing spawning habitat (e.g., for Sacramento splittail) and salmonid rearing habitat. Vegetation restoration of the area between the setback the river channel allow for re-introduction of native riparian species along the river corridor. This habitat benefits the wildlife that traditionally used the area and allows for connectivity between DFG wildlife areas along the river corridor.

Adverse Environmental Impact?

Constructing setback levees could result in moderate to substantial permanent impacts to terrestrial and agricultural habitats, and potentially to canal or seasonal wetland habitats, and in impacts to associated special-status species; however, the resulting benefits of reconnecting the river to the floodplain could outweigh the impacts.

Permitting Considerations?

Extensive and complex

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

The magnitude of adverse effects to habitats resulting from flood system O&M would be reduced. The availability of restored habitat resulting from setback levee projects could be used to provide mitigation for future projects streamlining the permitting for those future projects.

Social Considerations:

Public Safety?

Improves public safety by increasing the conveyance capacity between levees and reducing flood frequency.

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

Potential to provide significant water supply, recreation, and open space benefits. Reconnecting rivers to floodplains in low-risk areas provides an opportunity to increase groundwater recharge, improve water quality in a long-term sustainable way at

relatively low costs. Active flood plains and associated wetlands can temporarily store floodwaters, filter nutrients and impurities from runoff, process organic wastes, capture high sediment loads outside of the main flood channel, and moderate water temperature fluctuations. Construction of new linear features, such as setback levees, should always be considered for use as trail corridors, especially to connect existing trails or destinations of interest such as waterways and wildlife viewing areas.

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Political and institutional acceptability is likely to depend on local jurisdictions.

Technical Considerations:

Redirected Hydraulic Impacts?

May result in redirected hydraulic impacts upstream.

Residual Risk?

Reduces the frequency of flooding, reducing residual risk to existing development.

Climate Change Adaptability:

This action would enhance hydrologic adaptability by increasing capacity to convey flood flows; and this action would increase biological adaptability by increasing habitat quantity, connectivity, complexity, and continuity along environmental gradients, and thus, increasing the viability of populations and their ability to adjust to and handle the consequences of climate change (e.g., extreme events). The addition of riparian forest would provide greater carbon sequestration and assist in meeting DWR's climate change goals. Would allow the system to better adapt to sea level rise without increasing flood risk due to greater channel capacity.

Urban, Small Community, and Non-Urban Considerations:

May be limited opportunities to set back levees in urban areas with significant floodplain development. Rural counties and levee districts will need to be included in decision making process.

Regional Applicability:

All regions

Integration with Other Programs:

Flood Corridors Program (Projects Office), Corridor Management Strategy (FMO), Central Valley Conservation Strategy (FESSRO)

References:

RCR; Delta Risk Management Strategy;

DRAFT Management Action Evaluation

Management Action Title: MA-048

Reconnect floodplains to restore seasonal habitat.

Description:

Problem:

In many locations, floodplains have been disconnected from rivers and streams through the construction of levees, transportation infrastructure, or other features. This disconnect has curtailed the various beneficial functions of natural floodplains, which can provide important seasonal habitat, floodwater storage and flow attenuation, infiltration/recharge, and other natural floodplain processes.

Desired Outcome:

Reconnect historical floodplains to increase flood water storage, attenuate flood flows, and enhance wetland and riparian habitats. Increased riparian forest restoration would also lead to greater carbon sequestration and reducing our impact on global climate change.

Methodology:

Reconnect historical floodplains by expanding the current flood corridors. Rivers and streams can be reconnected to their floodplains by removing or modifying embankments, levees, or other features that prevent flood flows from entering floodplains. This might include lowering levee crowns to permit overflows at certain flood stages, constructing weirs or other features to control the passage of flood flows into adjoining floodplains, or removing embankments completely. Floodplain restoration should consider potential conflicts with existing urban and agricultural uses, local zoning regulations, local economies, private property rights, and water rights.

CVFPP Goals

Contributes Significantly to: Promote Ecosystem Functions

Potentially Contributes to (Check all that apply):

- ☑ Improve Flood Risk Management
- ☐ Improve Operation and Maintenance
- ☑ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☑ Promote Multi-Benefit Projects

Recommendations (Retained/Not Retained/Requires Further Evaluation):

Retain for further evaluation

Advantages:

- Will complement actions to develop transient floodplain storage for flood risk reduction.
- Promotes multiple benefits (flood risk reduction, groundwater recharge).
- Provides greater flexibility to adapt to changing climate conditions.

Disadvantages:

- Potential impacts to existing floodplain uses (site specific).
- Potential high costs for farmer compensation and/or land or floodway easement acquisition.
- Critical infrasturcture modifications may also result in significant costs.

Economic Considerations:

Capital Cost? (High, Medium, Low)

Low to high initial investment, depending on location and extent of floodplain storage (cost factors include real estate acquisitions, relocations, mitigations cost, and complexity of structural modifications to existing facilities).

Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)

Potential to increase annual maintenance costs depending on the maintenance requirements of the overflow area and

associated hydraulic structure(s).

Potential for Cost-Sharing?

Potential for non-governmental agency cost sharing and Federal cost sharing via contributions to existing federal project purposes (environmental restoration, flood risk reduction, water supply)

Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)

Cannot determine at this time.

Flood fighting? (Increase, Decrease, or No Significant Change)

Cannot determine at this time. Could be indirect effects if the State maintained the floodway increase.

Effect on Damage to Critical Public Infrastructure?

Cannot determine at this time (site specific), but could put additional strain on infrastructure not originally designed to withstand seasonal flooding (i.e. bridges, buried pipelines, electrical transmission towers, cell towers).

Effect on Floodplain and Economic Development?

Reconnection of floodplains and restoration of seasonal habitat would affect existing and potential future uses of those lands (prevent future urban development); could have negative impact on local economies. There is also a possibility to limit seasonal agricultural activities depending on the location.

Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)

This action would likely be combined with creation of transitory storage and therefore may increase the area of responsibility, but decrease the potential for liability. Floodplains also have a natural capacity for flood storage, which can help attenuate flood peaks and reduce both peak stages and velocities in adjacent river channels.

Environmental Considerations:

Rehabilitate key physical processes and ecological functions?

Reconnection would restore natural floodplain processes and support seasonal habitat development (seasonal wetland, spawning and rearing habitat, riparian, shaded riverine aquatic). The restoration of seasonal habitat will benefit native riparian vegetation and wildlife habitat. Riparian restoration will benefit river corridor connectivity for multiple species. These benefits will result in general benefits to all flora and fauna species and even more so to endangered species.

Adverse Environmental Impact?

Unable to determine at this time (site specific, and dependent upon land uses and habitat currently existing in floodplains to be reconnected); construction activities associated with this measure (embankment removal, weir or overflow construction) could have minor to moderate, temporary impacts (and potentially permanent impacts); however, these impacts would likely be offset by the benefits associated with floodplain restoration. Fish stranding would need to be a design consideration to avoid impacts to special-status and native fish species.

Permitting Considerations?

Minor to substantial, but streamlined depending on site specifics. Possibility to provide advance mitigation credits thereby streamlining the permitting process.

Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?

Additional transitory storage and seasonal habitat creation would benefit fish and wildlife species and likely reduce maintenance requirements by relieving pressure on surrounding levees during flood events. Any maintenance requirements could be offset by the mitigation credits for habitat creation.

Social Considerations:

Public Safety?

Floodplains have a natural capacity to attenuate floods; reconnection and restoration have the contributing potential to

improve public safety beyond what has already been accomplished with Yolo Bypass, Sutter Bypass, and Butte Sink.

Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?

Potential to contribute to groundwater recharge, water quality improvement

Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?

Potential implementation challenges relate to changes in existing and potential future land uses, land acquisition, responsibilities for long-term maintenance of restored habitat

Technical Considerations:

Redirected Hydraulic Impacts?

Site specific depending on location, but could put additional strain on infrastructure not originally designed to withstand seasonal flooding (i.e. bridges, buried pipelines, electrical transmission towers, cell towers).

Residual Risk?

No expected change, but unknown at this time.

Climate Change Adaptability:

This action would enhance hydrologic adaptability by increasing water management flexibility, and would enhance biological adaptibility by improving habitat connectivity and increasing habitat quantity to sustain population viability. Carbon sequestration abilities would also increase.

Urban, Small Community, and Non-Urban Considerations:

Floodplain restoration likely not feasible in urban areas or areas with small communities. Therefore, this is likely to occur in rural areas which will require stakeholder participation and buy-in from ranchers and farmers, which may be difficult.

Regional Applicability:

Potentially in all regions.

Integration with Other Programs:

Flood Corridors Program (Projects Office); FESSRO; FMO

References:

TFNBBF, 2002